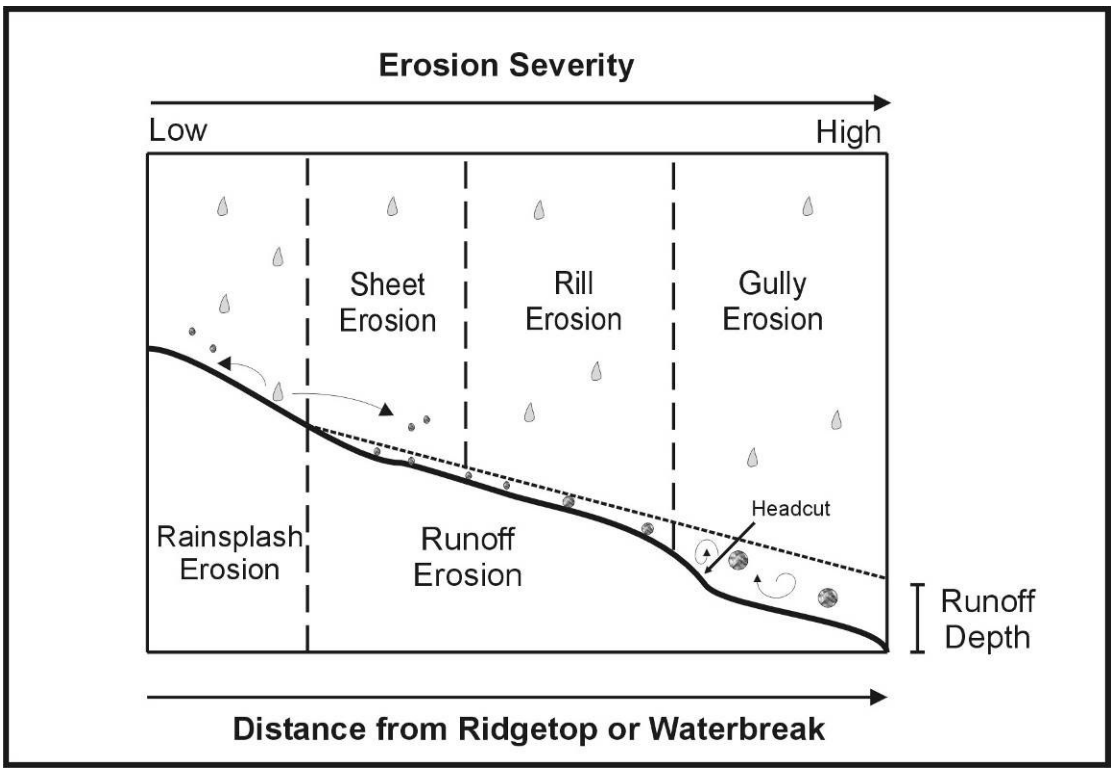


Figure 5. Stages and severity of surface erosion as a function of distance from ridgetop or waterbreak.

Once it has occurred, mass movement is relatively easy to identify in the field. Look for landslide scars on the hillslope (Figure 6), or large sediment deposits near the watercourse. A landslide scar is the bare surface left by the movement of rock or unconsolidated soil. Sediment volume can be rapidly estimated by multiplying the area of the landslide scar by the depth of the scar.

3.2. Determining Significant Pollution at the Watershed Scale

Determining significant pollution at the watershed scale requires visual monitoring of instream conditions. It is difficult to evaluate significant pollution via instream monitoring because the condition of the stream may be a result of natural erosion, manmade erosion, or both. Visual instream monitoring can be a useful tool for determining the location of significant sources of hillslope erosion. This can be done by observing the clarity of water at different locations (i.e., upstream or downstream) in the THP area. Visual monitoring of water clarity (i.e., turbidity) is especially useful at road-stream crossings because you can look at water quality above and below the crossing to determine if significant pollution is occurring.

Figure 6. Looking down at a landslide scar**.**

Other indicators of significant pollution at the watershed scale include gravel embeddedness, pool sedimentation, stream channel aggradation, bank erosion, and stream channel degradation (i.e., downcutting; channel incision).

Gravel embeddedness is the degree to which fine sediment (i.e., sand sized and smaller) surrounds gravels and cobble on the surface of the stream (Figure 7). Embeddedness becomes higher as gravel and cobbles become more and more buried by fine sediment.

Pool sedimentation is the presence of fine sediment in pools. Pool sedimentation indicates high rates of fine sediment delivery to a stream channel (Figure 8). It is recognized as sand sized (i.e., less than 1/12th an inch in diameter), or smaller, particles that deposit in a channel pool. Fine sediment in pools is typically more indicative of watershed wide sediment production rather than pollution from individual timber management activities.

Stream channel aggradation is when the elevation of the stream channel rises in response to excess sediment. It is indicative of high rates of coarse sediment delivery (i.e., 1/12th an inch in diameter or greater) to a stream channel. Channel aggradation is typically associated with large inputs of sediment from landslides or failed road-stream

crossings. Channel aggradation typically causes a widening of the stream and overbank flooding.

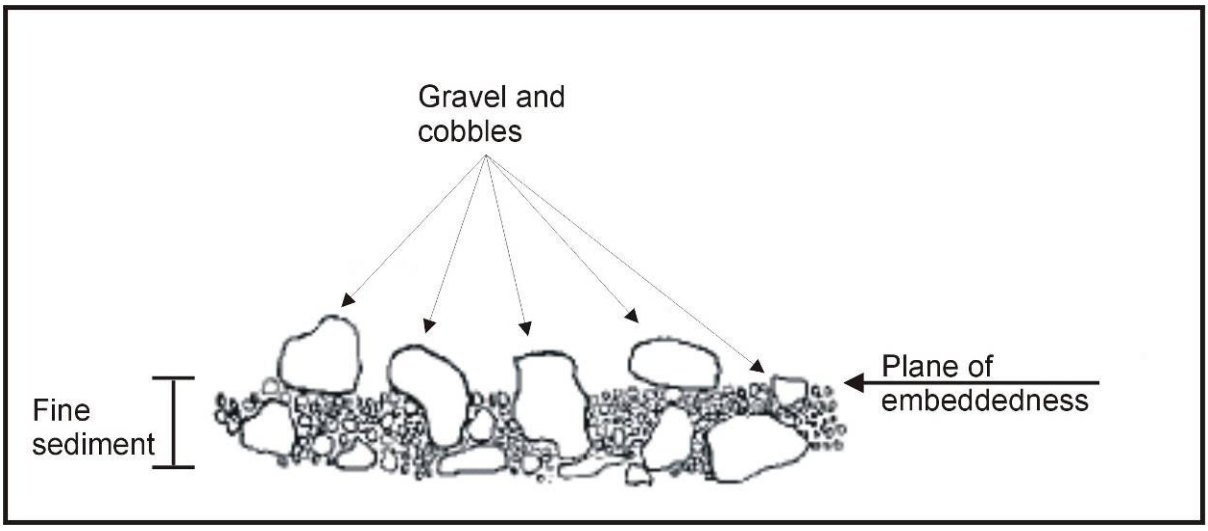
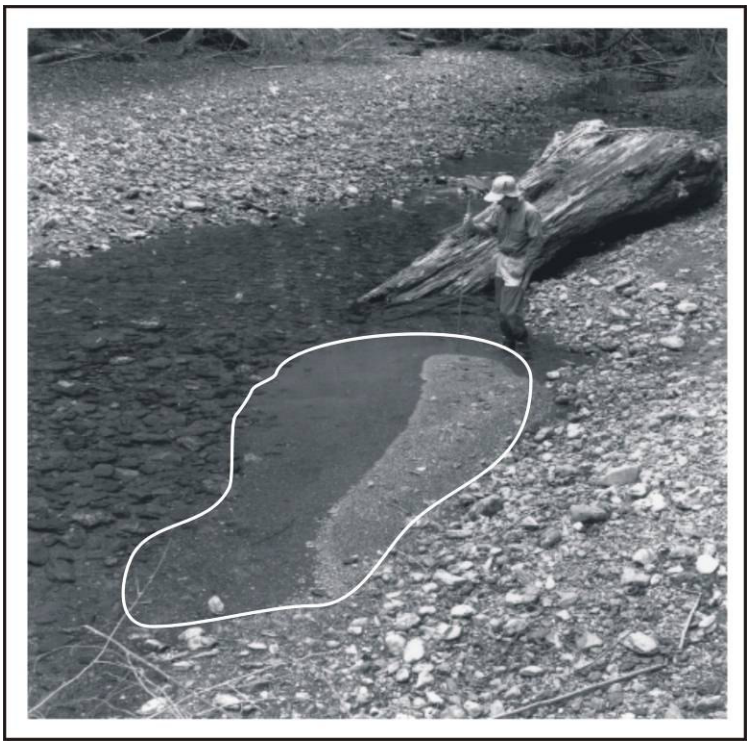


Figure 7. A schematic illustrating gravel/cobble embeddedness. Embeddedness increases as the plane of embeddedness covers most of the gravel/cobbles (from Bunte and Abt, 2001).

Bank erosion may occur when trees are harvested on the banks of channels. There is speculation that bank erosion can increase due to timber harvest-induced increases in peak flows. However, it is generally difficult to visually link the hydrologic effects of timber harvest to increased bank erosion.

Figure 8. Fine sediment deposition in the pools of a watercourse indicates a high supply of sediment from upstream sources (picture taken from Lisle and Hilton, 1999).



Stream channel degradation (i.e., stream downcutting) can result from landsliding or peak flow events. Scour from landsliding (i.e., debris flows) can cause downcutting if the receiving channel is steep enough. Downcutting can also occur in response to large peak flows or the local modification of channel hydraulics. Stream downcutting is common when road runoff is drained into small channels (i.e., Class III channels). The process of channel downcutting produces significant pollution.

4.0. What Type of Monitoring Do I Need to Do and How Do I Do It?

The type of monitoring required by the landowner depends upon the Waiver category that the activity is covered by and the threat to water quality posed by the timber harvest activities. The most common forms of monitoring required under the Waiver are agency monitoring, implementation monitoring, forensic monitoring, effectiveness monitoring, and photo-point monitoring. In rare instances, landowners may be required to do water quality compliance monitoring, assessment monitoring, and/or trend monitoring. **Figure 9 provides the landowner with a quick way to determine monitoring requirements and Figure 10 illustrates the timelines for each type of monitoring.**

The various types of monitoring are described below:

4.1. Agency Monitoring:

Agency monitoring is required for all Waiver categories (Figure 9), but since it is done by regulatory agencies it requires little effort by landowners. Agency monitoring is monitoring conducted by the California Department of Forestry (CDF) and the Regional Board on private lands, and the United States Forest Service (USFS) on federal lands. These agencies evaluate compliance with CDF's Forest Practice Rules or USFS best management practices (BMP) guidance documents. Even though the landowner does not do agency monitoring, landowners should request a written record of any agency inspection done throughout the life of the project, with the exception of Regional Board monitoring reports, and submit it in their annual report. Agency monitoring must be done before November 15 to be used in place of implementation monitoring.

4.2. Implementation Monitoring:

The most important type of monitoring is implementation monitoring. Implementation monitoring is typically required for Waiver categories 2 through 5 (Figure 9). Implementation monitoring determines whether management measures were carried out as planned. In simple terms, implementation monitoring answers the question, "Did we do what we said we were going to do?" Implementation monitoring consists of detailed visual monitoring of hillslope features (i.e., roads, landings, skid trails, watercourse crossings, WLPZs, and unstable areas); with emphasis placed on determining if management measures (such as erosion control measures, riparian buffers) were implemented or installed in accordance with approved timber harvest projects. This type of monitoring specifically addresses whether management measures were implemented according to the Forest Practice Rules, THP language, Regional Board recommendations, and Waiver criteria. Special focus should be placed

on evaluating the implementation of recommendations made by Regional Board staff during pre-harvest inspections (PHIs).

Implementation monitoring may include photo-documentation of installed management measures (photo-point monitoring). A "final compliance report" or "work completion report" inspection, conducted by CDF prior to the winter period and after cessation of active harvesting and road construction, may be substituted for the required pre-winter inspection if the inspection covers the entire plan area and the report is submitted to the Regional Board before December 1.

Implementation inspections should only be conducted where timber harvest activities have taken place. For THP areas with actively logged areas, implementation inspections shall be conducted as follows:

- *Where timber harvest activities have started and no winter operations are planned* – A pre-winter implementation inspection shall be completed by November 15 of each year.
- *Where timber harvest activities have started and winter operations are planned* – A pre-winter implementation inspection shall be completed by November 15 of each year for areas not subject to winter operations. Also, an implementation inspection shall be completed immediately following cessation of winter period operations in areas where winter operations occurred.

Once you've determined the portions of the THP area that have the highest risk to water quality, it will be necessary to determine if management measures (i.e., mitigations and best management practices) have been implemented in these areas prior to the winter season.

The things to consider when determining if management measures are properly implemented are the following:

4.2.1. Unstable Areas

Avoidance is the typical mitigation when operating near unstable areas. However, operations within unstable areas can be permitted if explained and justified in the THP. If unstable areas are present within the THP area, inspect for the following:

- ***Were the unstable areas avoided during timber harvest activities?*** Unless allowed in the THP, make sure that timber harvest activities did not occur within the unstable areas.

- ***Make sure that timber harvest activities do not cause runoff to be drained into unstable areas.*** Make sure that waterbreaks on roads, skid trails, or cable roads drain water away from unstable areas.

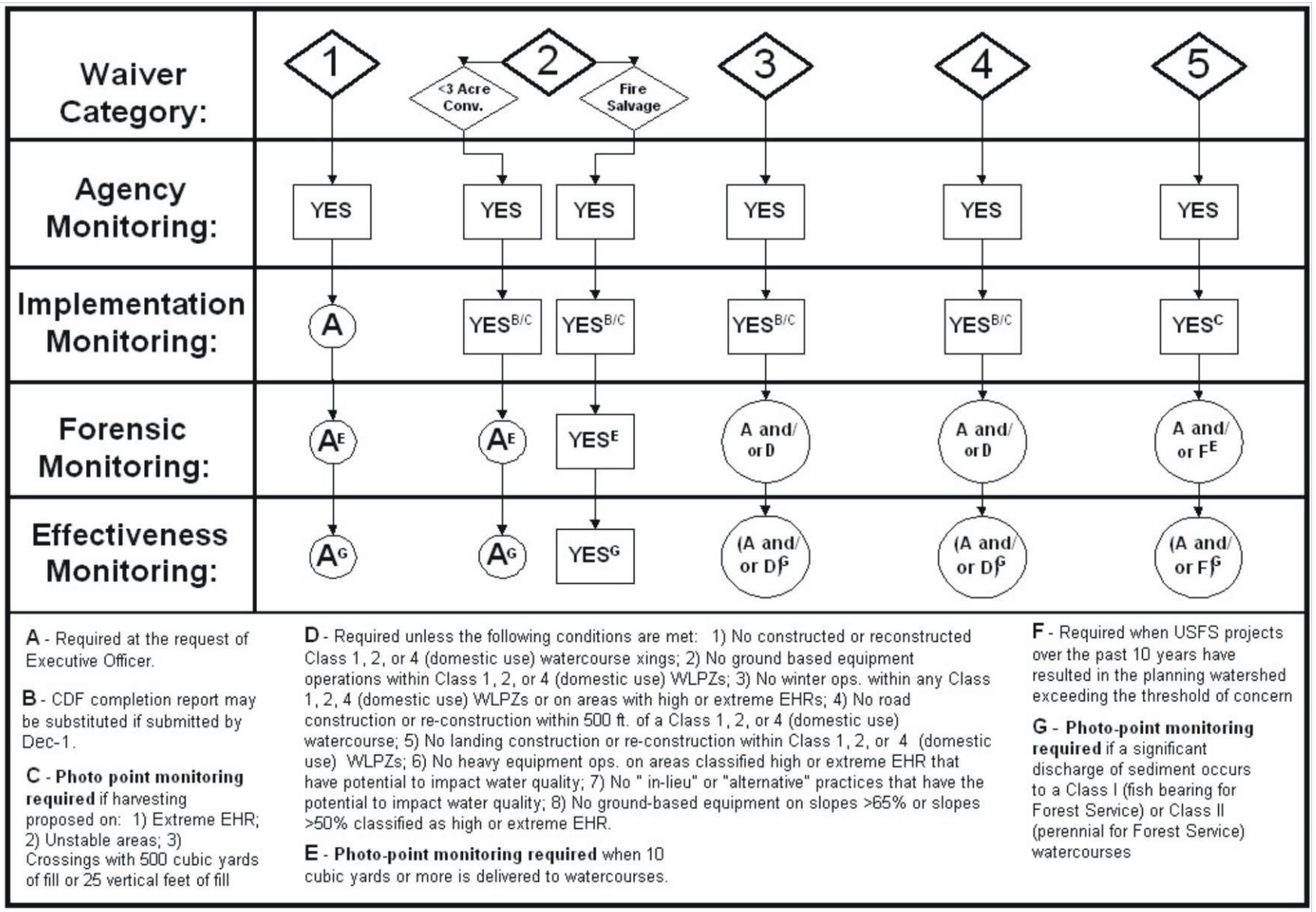


Figure 9. Monitoring requirements by Waiver category.

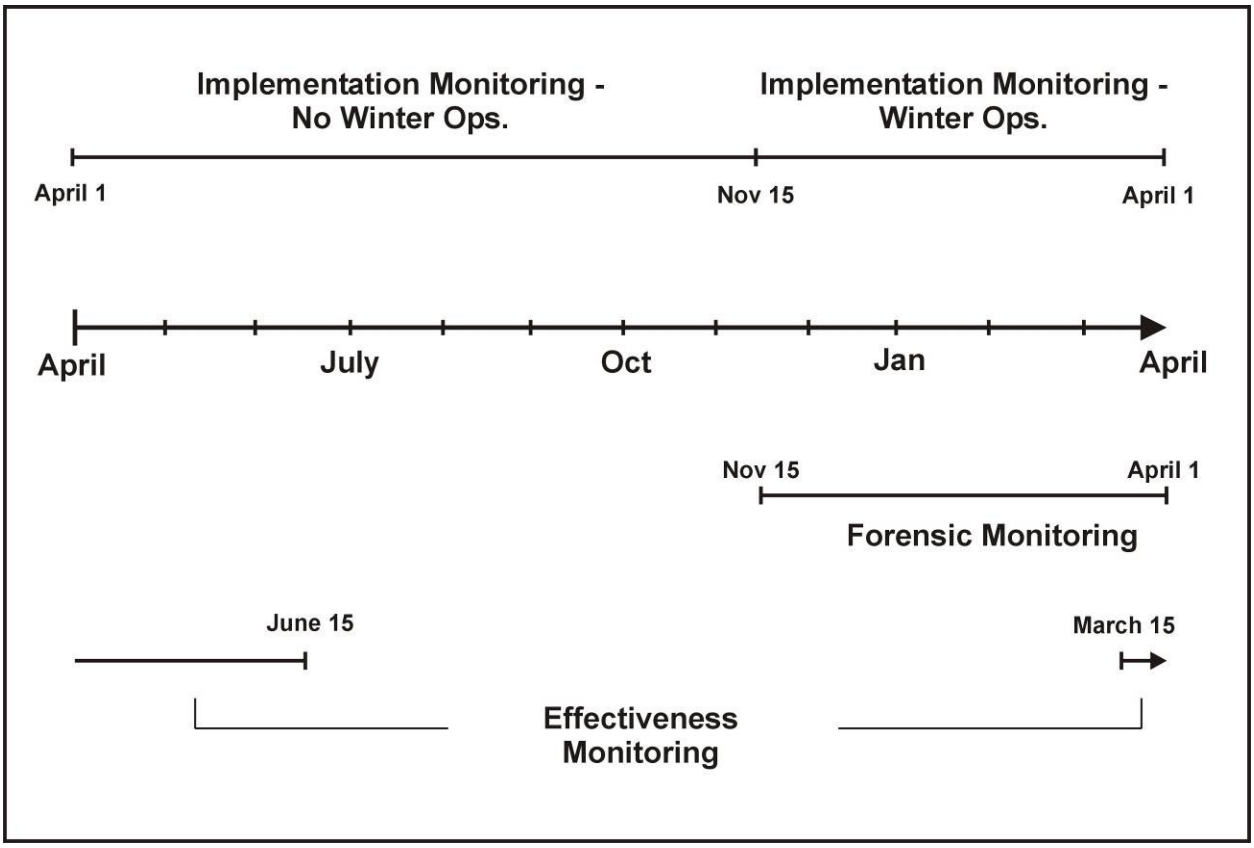


Figure 10. Timelines for Waiver monitoring.

- ***If timber harvest activities are permitted within unstable areas, make sure that site-specific mitigations listed in the THP are implemented.*** If the use of ground based equipment is proposed within unstable areas, site-specific mitigations will be listed in Section II, Item 21.a. of the paper THP. If roads are proposed for construction or reconstruction in unstable areas, site-specific mitigations will be listed in Section II, Item 24.b. If landings are proposed for construction or reconstruction in unstable areas, site-specific mitigations will be listed in Section II, Item 24.i.

4.2.2. Road-Stream Crossings

Check stream crossings to determine if management measures are implemented correctly. If Section II.26.c. of the paper copy of the THP is checked yes, then you will have to check to see if the culvert(s) and associated fills were installed and constructed consistent with the THP language and the California Forest Practice Rules (http://www.fire.ca.gov/resource_mgt/downloads/2010_FP_Rulebook_w-Diagrams_wo-TechRule_No1.pdf). Inspect for the following at newly-constructed or reconstructed crossings:

- ***If a new culvert is installed, is the diameter of the culvert the same size or larger than the diameter specified in the plan[4]?*** Check Section II.26. of the THP to see if the diameter of the newly installed culvert is consistent with diameter specified in the plan.

- ***Has the culvert been installed along the natural grade of the channel (see Figure 11)?*** Culverts that are not installed along the natural channel grade can cause deposition of sediment at the inlet, road fill erosion, channel erosion, and prevent fish passage.

Figure 11. A picture of a culvert that was not set to the natural grade of the channel. These culverts are often referred to as "shotgunned" culverts.

- ***Is the culvert properly aligned with the channel?*** Culverts that are not properly aligned with the channel are more susceptible to plugging by sediment and debris (Figure 12).

- ***If inlet scour is a potential issue, is the inlet properly armored against scour?*** Scour is erosion by water current. To determine if inlet scour is an issue, look at the average size of rock in the channel above the influence of the crossing. If it is much larger than the fill material or rock armor, then the inlet is not adequately protected against scour. Armor should be placed below the point of scour, keyed into the fill to increase stability, and be sized to resist flow velocities during the 100-year flood (Figure 13).

[4] The crossing must also be appropriately sized for the 100-year flood.